HEAT-CONDUCTING SUPPORT FOR CURVED BOTTOM VESSELS

BACKGROUND OF THE INVENTION

The present invention relates to a heat-conducting support for a round or curved bottom vessel, such as a round bottom flask.

Heating elements such as hot plates or stirring hot plates are frequently used in laboratories for heating various vessels. Unfortunately, such heating elements provide poor support and heat transfer for vessels which do not have a flat bottom, in particular round bottom flasks.

A number of supports are known. For example, US Design Patents 295,963 and 307,869 basically provide support only, and are not designed as, nor suitable as, heat-conducting supports, also referred to herein as thermal adapters or heating mantles. These known supports have no portion that is complementary to the shape of a flask in order to be able to conduct heat in an efficient manner to the flask.

US Patent 4,249,069 discloses a hollowed-out block with a heating element for directly heating a flask. Thus, this patent provides an entire flask heater assembly and is not a thermal adapter.

US Patent 4,305,559 discloses a flask support having a honeycomb construction. Although this device provides a thermal

adapter, it is very complex, expensive to produce, and difficult to clean, and therefore does not provide a very satisfactory thermal adapter.

It is therefore an object of the present invention to provide a simple heat-conducting support or thermal adapter that is shaped to support a curved bottom vessel, and which also provides improved heat transfer to a vessel from a flat heated surface.

BRIEF DESCRIPTION OF THE DRAWINGS

This object, and other objects and advantages of the present invention, will appear more clearly from the following specification in conjunction with the accompanying schematic drawings, in which:

Fig. 1	is a cross-sectional view through one exemplary embodiment of an inventive heat-conducting support;
Fig. 2	is a top view of the support of Fig. 1;
Fig. 3	is a cross-sectional view through another exemplary embodiment of an inventive heat-conducting support; and
Fig. 4	is a top view of the support of Fig. 3.

SUMMARY OF THE INVENTION

The heat-conducting support of the present invention is characterized primarily by a metallic unit having an inner portion, an

outer portion, and a base for placement on a heating element, wherein the inner portion is concavely curved to support a vessel having a round or curved bottom, wherein the outer portion adjoins the inner portion at an upper location remote from a curved bottom of the inner portion, and wherein the outer portion extends away from the upper location of the inner portion toward the base and is connected thereto, or merges therewith.

The support or thermal adapter of the present invention is preferably made from a single non-magnetic sheet of metal, especially aluminum or copper. It is easy to produce, and is very light in weight. Nonetheless, the inventive heat-conducting support provides surprisingly good heat transfer, without having to be provided with a complex structure, such as the honeycomb structure of the aforementioned US Patent 4,305,559. Furthermore, spills or the like are much easier to clean up with the inventive support. In addition, the inventive heat-conducting support is very convenient to store, since several units could be compactly stacked or nested together.

Further specific features of the present invention will be described in detail subsequently.

DESCRIPTION OF PREFERRED EMBODIMENTS

Referring now to the drawings in detail, Fig 1. shows one exemplary embodiment of the inventive heat-conducting support 20 for a round or curved bottom vessel, such as a flask, especially a glass flask.

The inventive heat-conducting support 20, also known as a heating mantle or a thermal adapter, is preferably a lightweight device and includes an inner portion 21 that is concavely curved to thereby provide an outer surface that is substantially complementary to the curved lower surface of a curved or round bottom vessel. In particular, the inner portion 21 is provided with a curved or concave bottom 22.

The heat-conducting support 20 furthermore has an outer portion 24 that adjoins the inner portion 21 at the upper location 25. In the illustrated embodiment, the outer portion 24 extends downwardly toward the base 26 at an angle outwardly away from the inner portion 21. It is to be understood that the outer portion 24 could also have a cylindrical shape, the shape of a truncated pyramid, or any other at least largely closed shape, although an outward taper for the outer portion 24 may be preferred for reasons of stability and to facilitate construction.

As indicated above, the outer portion 24 extends to a base 26, with which it preferably merges, so that a single piece of metal can be

used to produce the inventive heat-conducting support. The base could, however, also be a separate piece to which the outer portion is connected in any suitable manner, for example by being swaged or riveted thereto. The base 26 is substantially flat, or at least has a flat portion, for placement on a heating element such as a hot plate, burner or some other heating means. If separate, the base 26 can be a continuous piece which could also have apertures in order to save material, although apertures would detract from heat transfer. In addition, the base 26 can have any desired shape in order to rest as fully as possible on the heating element. In the embodiment illustrated in Figs. 1 and 2, the base is shown as having an essentially square configuration, with the corners preferably being rounded off. The base can also have any other desired shape, such as the circular shape that will be described subsequently in connection with Figs. 3 and 4.

As can be seen from Fig. 1, the heat-conducting support 20 essentially has the shape of a hat, the crown of which is dished to provide the curved or concave inner portion 21 and bottom 22. In this connection, although in the illustrated embodiment the curved or concave bottom 22 is shown as extending to the plane of the base 26, the bottom 22 could also be slightly spaced from the plane of the base, as in the embodiment shown in Fig. 3. If the bottom is in the plane of the base, it would also rest on a heating element. If desired, to

enhance the conduction of heat to the heat-conducting support, the bottom 22 could also have a small flattened portion.

In the preferred embodiment of Figs. 1 and 2, the base 26 of the heat-conducting support 20 is shown as a brim 27 that extends radially outwardly from where the outer portion 24 meets the base 26. The space indicated by the reference numeral 29 is thus open toward the bottom, and can thus be heated by a heating element for radiative and/or convective heating of the inner portion 21. Although the brim 27 is not absolutely necessary, it provides rigidity and support for the unit and also provides for increased contact of the base 26 of the unit with a heating element, and hence better conductive heat transfer. It is to be understood that the brim could be extended as far as necessary, or could be eliminated, in which case the lower end of the outer portion 24 would provide the support for the unit, as well as moderate contact with a surface of a heating element.

The heat-conducting support 20 is preferably made of a non-magnetic, heat-conductive metal, either as a single layer of metal, or as a multi-layer sheet of metal. The presently preferred material for the support 20 is aluminum or copper, although any other suitable heat-conducting metal could be used. In addition, although when the metal is a multi-layer sheet of metal (see Figs. 3 and 4), the layers are disposed adjacent to one another with little or no air gap, and the material itself is not honeycombed.

In one exemplary embodiment of the heat-conducting support 20 of Figs. 1 and 2, the base 26, namely the brim or outer section 27, has a width of 3.1 inches, with the brim 27 extending, for example, ¼ to 1 inch outwardly from the outer portion 24. The height of the exemplary embodiment was 0.75 inches, and the unit was made from an aluminum sheet having a thickness of 0.035 inches. The support 20 was designed to accommodate a 50 ml round bottom flask. The weight of the support or mantle 20 was only 13 grams.

An alternative exemplary embodiment of an inventive heat-conducting support is illustrated in Figs. 3 and 4 and is designated generally by the reference numeral 20'. Those components that are identical or similar to those described in conjunction with Figs. 1 and 2 have the same reference numerals as in the first embodiment.

The heat-conducting support 20' shown in Fig 3 also has a hat-shaped configuration. However, in this embodiment the outer portion 24 is curved more to the outside and thus extends the base 26 further outwardly. In addition, a curved or concave bottom 22 of the inner portion 21 is shown spaced from the plane of the base 26. It is to be understood that the bottom 22 could also be in the plane of the base, as was described in conjunction with the first embodiment.

In this embodiment, the material is a multi-layer sheet of metal, such as aluminum. However, again a single layer sheet of metal could be used to construct the various parts of the support.

In the illustrated embodiments, at least the outer portion 24 and the inner portion 21 are preferably made of a single, monolithic sheet of metal, although if desired the two portions could also be made of separate sheets of metal and then appropriately connected to one another, such as at the upper location 25, which could also be wider than shown to facilitate stacking or nesting of several units.

In one specific embodiment of the heat-conducting support 20' of Figs. 3 and 4, the base, which in this case is illustrated as being round, has a diameter of 5.1 inches, with the height of the unit being 1.1 inches. This embodiment also was designed for a 50 ml round bottom flask. The weight of this unit was 36 grams.

The advantages of the present invention will now be more clearly demonstrated in conjunction with specific examples.

EXAMPLE ONE

A control or reference test was first run. In particular, the stirring control dial of a small ceramic-top stirring hot plate was turned off, and the heating control dial was set so that the temperature at the middle of the flat heating surface equilibrated at 280°C. 25 ml of water at 23°C was placed in a 50 ml round bottom flask, and the flask was clamped in a vertical position on the middle of the heating surface. The temperature of the water in the flask was then measured as a function

of time. Eighteen minutes of heating time was required in order to bring the water in the flask to a boil.

EXAMPLE TWO

The next test was conducted with an inventive aluminum support of the type illustrated in Fig. 1. The test was run in the same way as with the reference run, except that the water-containing flask was placed in the inventive support on the curved or concave bottom thereof. The flask was then clamped in position. With the inventive support, only 7 to 8 minutes of heating time were required before the water in the flask began to boil.

EXAMPLE THREE

Whereas the first series of tests were done on an open laboratory bench, outside of the fume hood, a second series of tests was conducted inside of the fume hood, which provided a good draft of air. Again a control run was first conducted on the small stirring hot plate. Due to the air draft of the hood, a higher dial setting was required so that the temperature at the middle of the flat heating surface equilibrated at 280°C. Otherwise, all of the conditions were the same as in Example One. In this test, even after heating the flask for 20 minutes, the temperature of the water was still less than 80°C and the heating curve had almost leveled out.

EXAMPLE FOUR

The test conditions of Example Three were now repeated with an inventive support of the type illustrated in Fig 1. In this case, the water was boiling after only 9.3 minutes.

It can be seen from the foregoing examples that the inventive heat-conducting support significantly increases the efficiency of heating round bottom flasks on a heating element.

The present invention is, of course, not restricted to the specific disclosure of the specification, the drawings, and the examples, but also encompasses any modifications within the scope of the appended claims.